



5...4...3...2...1...

SPACE LAUNCH SYSTEM

DEEP-SPACE DEPLOYMENT FOR SMALLSATS

Steve Creech
NASA Space Launch System
June 2017



SLS CAPABILITY AVAILABILITY

SLS Block 1 As Early As 2019

Provides

Initial Heavy-Lift Capability

Enables

Orion Test

SmallSats to Deep Space



SLS Block 1B Crew As Early As 2021

Provides

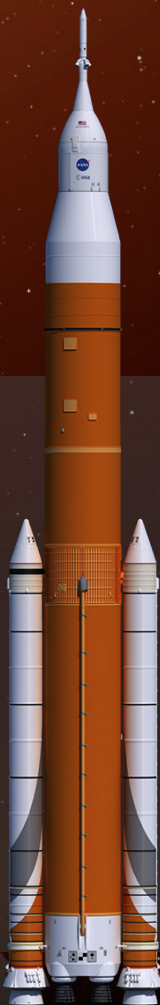
105 t lift capability via Exploration Upper Stage

Co-manifested payload capability in Universal Stage Adapter

Enables

Deep Space Gateway

Larger CubeSat- and ESPA-Class Payloads



SLS Block 1B Cargo As Early As 2022

Provides

8.4-meter fairings for primary payloads

Regular flight cadence for additional launches

Enables

Europa Clipper/Lander

Deep Space Transport

Large-Aperture Space Telescopes

Ice or Ocean Worlds Missions

Interstellar Medium



SLS Block 2 As Early As 2028

Provides

130 t lift capability via advanced boosters

10-meter fairings for primary payloads

Enables

Crewed Mars Orbit Missions

Crewed Mars Surface Missions



SLS BLOCK 1 CONFIGURATION

OVERVIEW

- Initial configuration of vehicle optimized for near-term heavy-lift capability
- Completed Critical Design Review in July 2015

SLS Block 1

Capability: >70 metric tons

Height: 322 feet

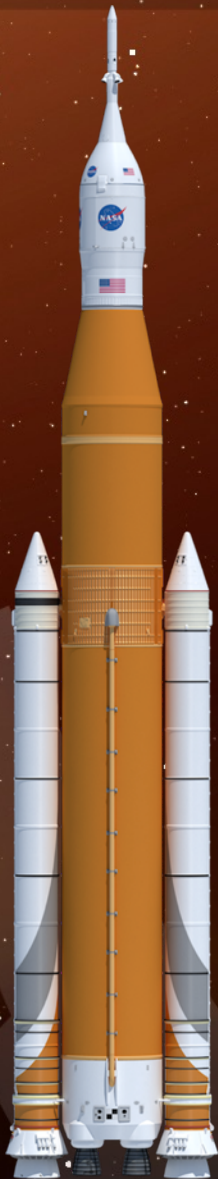
Weight: 5.75 million pounds

Thrust: 8.8 million pounds

Available: 2019

UTILIZATION

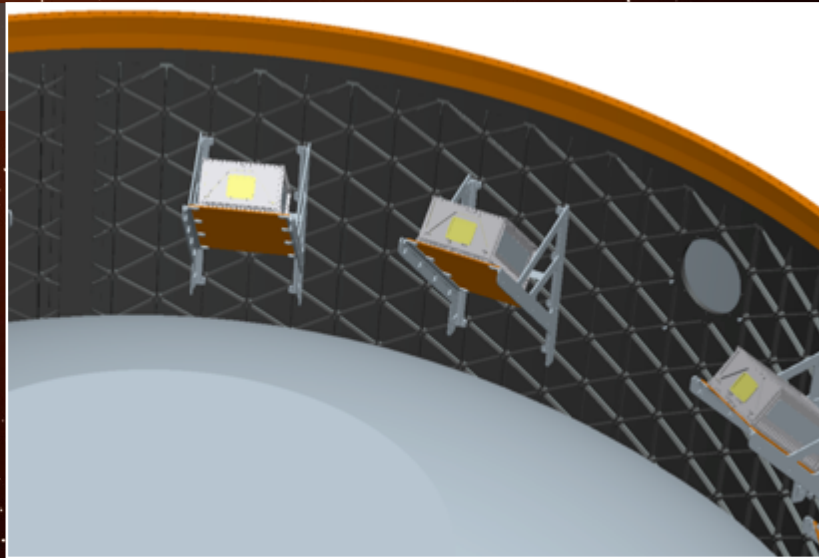
- Initial demonstration of Space Launch System and Orion capabilities
- Supports launch of Orion into distant retrograde orbit around the moon



EM-1 SECONDARY PAYLOAD CAPABILITY

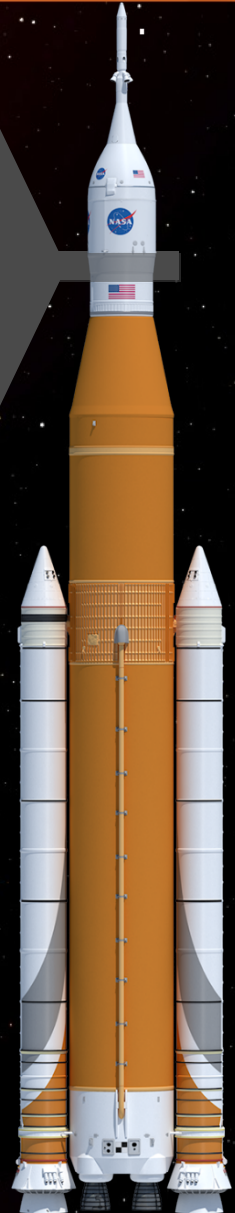
Accommodations

- SLS for Exploration Mission-1 will include thirteen 6U payload locations of up to 14kg per CubeSat



EM-1 Trajectory

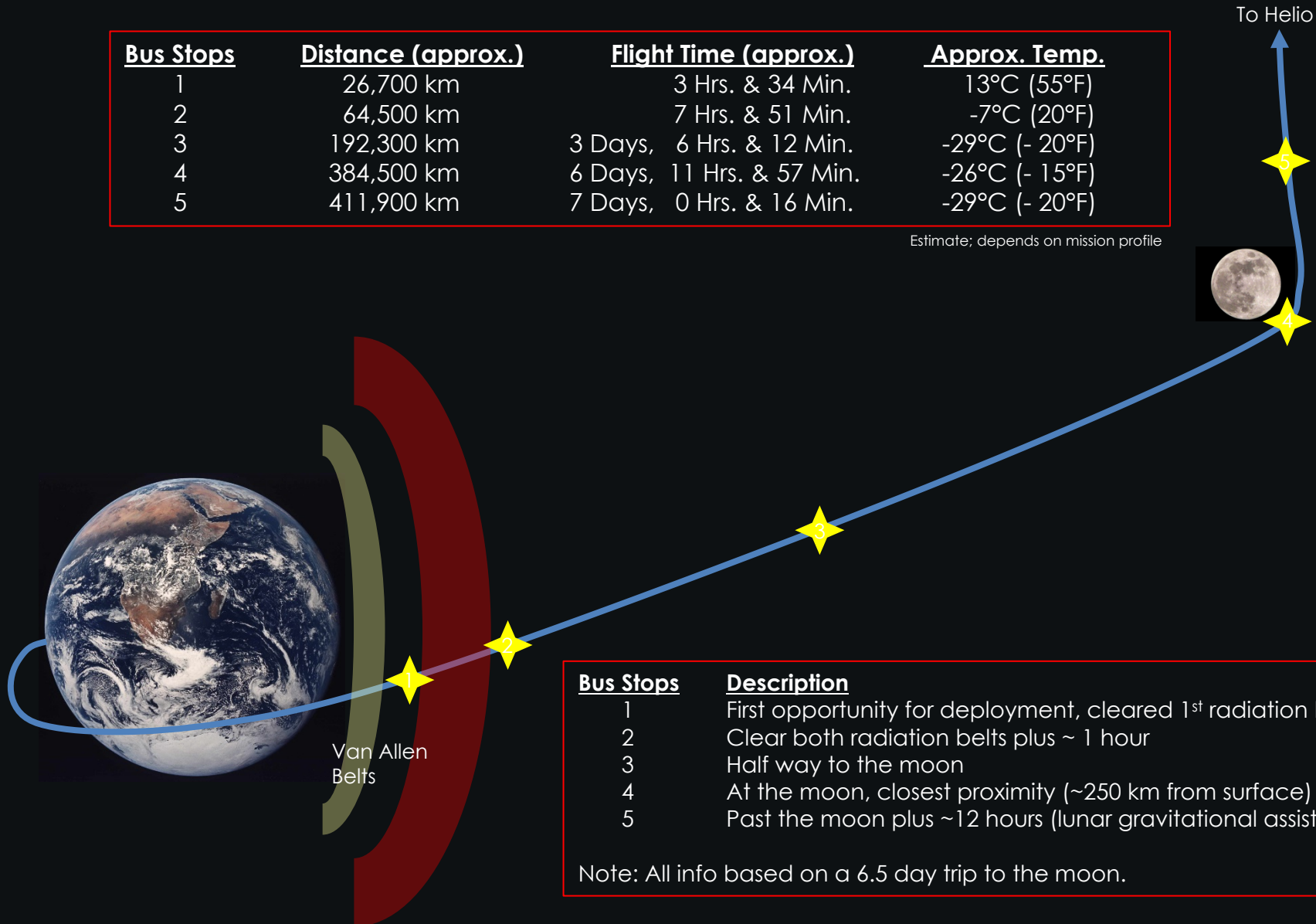
- Orion will enter Distant Retrograde Orbit around the moon
- Additional cislunar trajectories being studied for future missions



EM-1 CUBESAT BUS STOPS

<u>Bus Stops</u>	<u>Distance (approx.)</u>	<u>Flight Time (approx.)</u>	<u>Approx. Temp.</u>
1	26,700 km	3 Hrs. & 34 Min.	13°C (55°F)
2	64,500 km	7 Hrs. & 51 Min.	-7°C (20°F)
3	192,300 km	3 Days, 6 Hrs. & 12 Min.	-29°C (- 20°F)
4	384,500 km	6 Days, 11 Hrs. & 57 Min.	-26°C (- 15°F)
5	411,900 km	7 Days, 0 Hrs. & 16 Min.	-29°C (- 20°F)

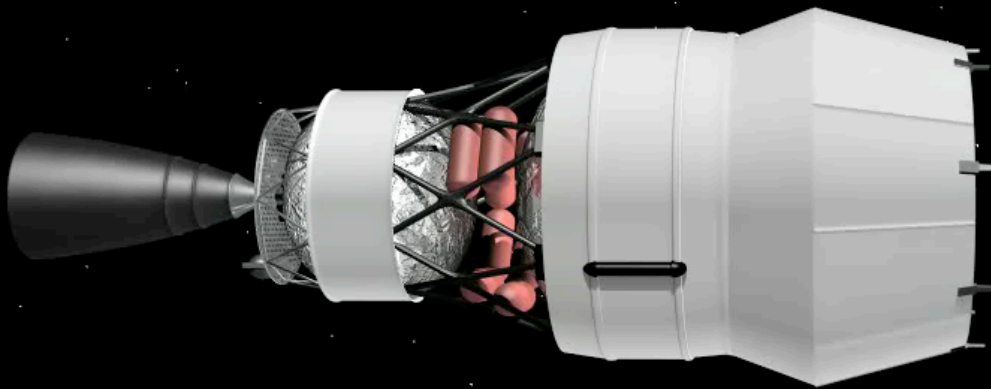
Estimate; depends on mission profile



<u>Bus Stops</u>	<u>Description</u>
1	First opportunity for deployment, cleared 1 st radiation belt
2	Clear both radiation belts plus ~ 1 hour
3	Half way to the moon
4	At the moon, closest proximity (~250 km from surface)
5	Past the moon plus ~12 hours (lunar gravitational assist)

Note: All info based on a 6.5 day trip to the moon.

CUBESAT DEPLOYMENT



ONE LAUNCH, MULTIPLE DISCIPLINES

Moon

- Lunar Flashlight (NASA)
- Lunar IceCube (Morehead State University)
- LunaH-Map (Arizona State University)
- OMOTENASHI (JAXA)

Asteroid

- NEA Scout

Sun

- CuSP (Southwest Research Institute)

Earth

- EQUULEUS (JAXA)
- Skyfire (Lockheed Martin)

And Beyond

- Biosentinel (NASA)
- ArgoMoon (ESA/ASI)
- Three Centennial Challenge Winners (TBD)

PROGRESS TOWARD LAUNCH



Core Stage production at Michoud



Booster testing at Orbital ATK



Engine testing at Stennis Space Center



Upper stage prep at Cape Canaveral



Structural testing at Marshall



Ongoing work for Block 1B

SLS BLOCK 1B CONFIGURATION

OVERVIEW

- Replaces Interim Cryogenic Propulsion Stage with human-rated Exploration Upper Stage
- EUS has completed checkpoint prior to Preliminary Design Review

SLS Block 1B

Capability: >105 metric tons

Height: 364 feet

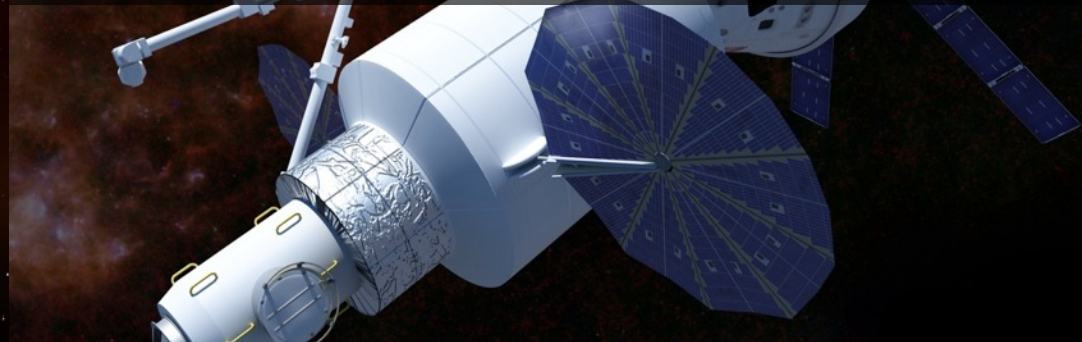
Weight: 6 million pounds

Thrust: 8.8 million pounds

Available: No earlier than 2021

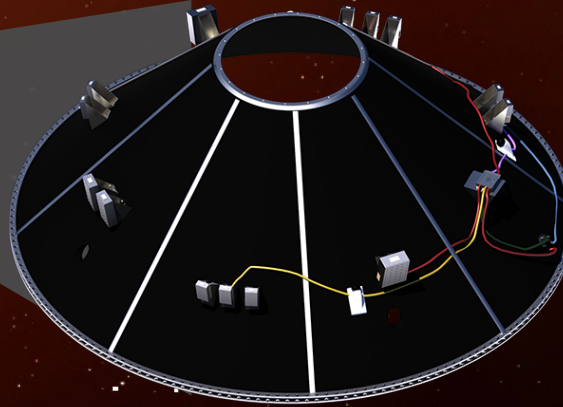
UTILIZATION

- Supports launch of Orion and co-manifested exploration systems in “Proving Ground” of cislunar space
- With large 8.4-meter fairing, can launch game-changing science missions and other high-priority payloads

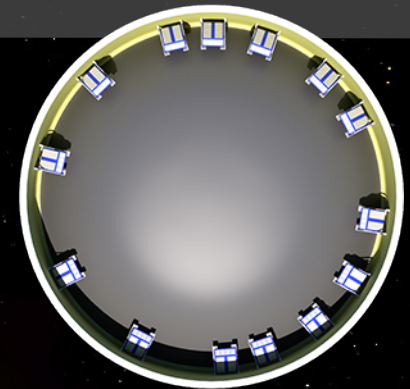
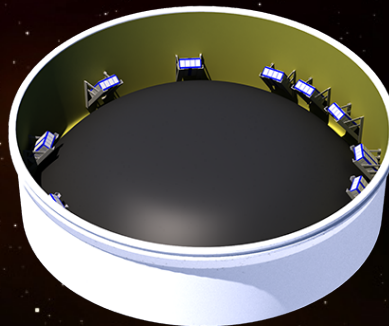


BLOCK 1 & BLOCK 1B COMPARISON

BLOCK 1B



BLOCK 1



BLOCK 1B SMALL PAYLOAD OPTIONS

VOLUME AND MASS RANGE



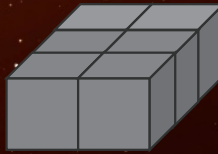
10
cm



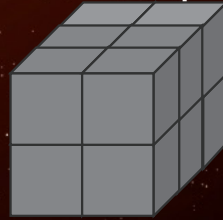
1U



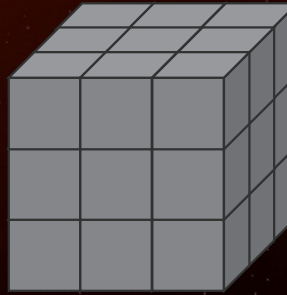
Football



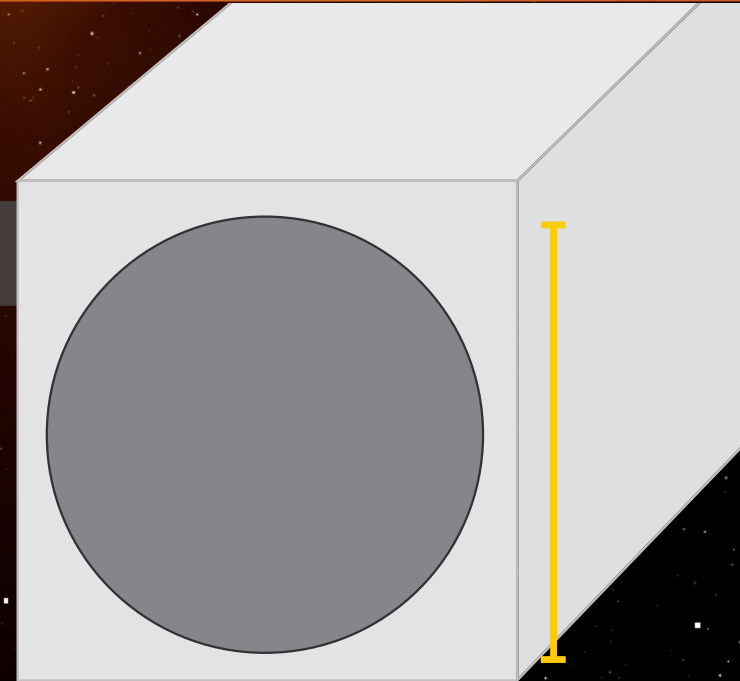
6U
14kg



12U
25kg

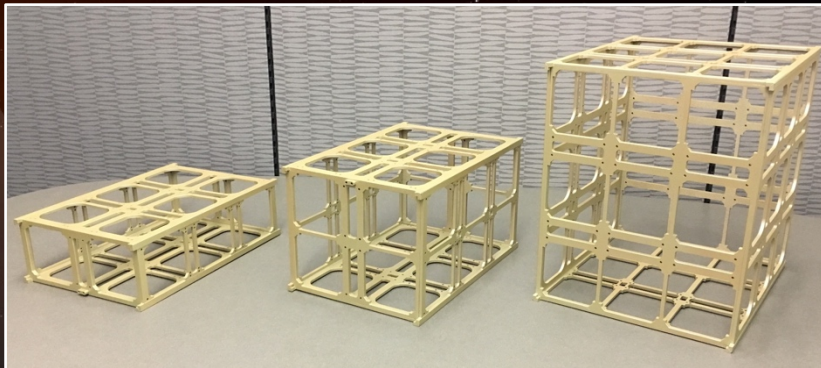


27U
54kg



Ring Payload Interface (Notional)
~180kg

~61
cm



Summary

- SLS provides a unique opportunity for the CubeSat/smallsat community
 - Enables access to Earth, Moon, Sun & Deep Space
 - Opportunity to manifest payloads from 6U/12U/27U to ESPA-Class
- First Flight (EM-1) hardware production in-progress
 - Block 1B initiating procurement/production activities

More Information

- SLS Mission Planner's Guide (ESD 30000)
 - Provides future payload developers/users with information to support preliminary SLS mission planning
 - Covers Block 1B (105mT*) & Block 2 (130mT*) configurations
 - Copies can be requested by email to:
NASA-slspayloads@mail.nasa.gov



* Payload Mass to Low Earth Orbit